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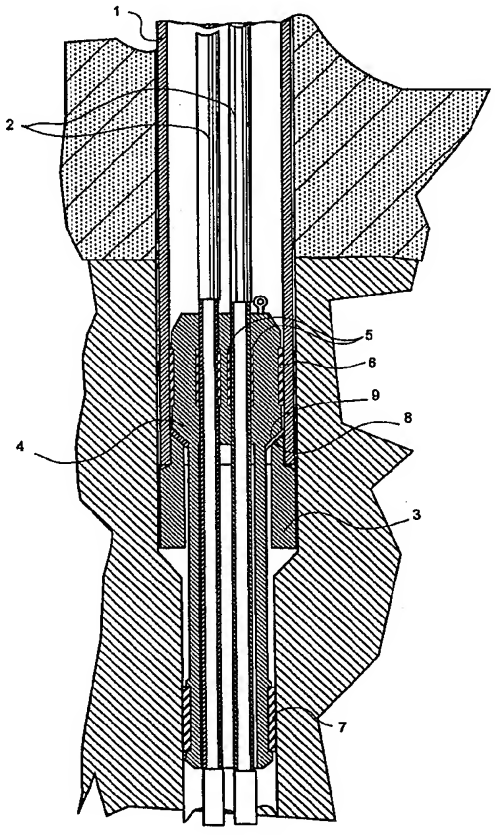
(57) Abstract

The present invention relates to a method and a device in wells, and preferably energy wells, for sealing thereof, said wells being of a kind comprising a well casing (1) and circulation pipes (2) extending inside said well casing, preferably for the circulation of a heat–exchange medium. According to the invention a tubular gasket (4) is fitted around the circulation pipes (2) so as to enclose the latter at least around part of their extension lengthwise and is arranged at the lower part of said well casing (1), a material (6) of a kind that expands upon its contact with a liquid, and in consequence thereof becomes sealing, being applied about the tubular gasket (4) to seal between said tubular gasket and the well casing (1).



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SEALING FOR ENERGY WELLS

The present invention relates to a method and a device in wells, and preferably energy wells, for sealing thereof, said wells being of a kind comprising a well casing and circulation pipes extending inside said well casing, preferably for the circulation of a heat-exchange medium.

In for example energy wells or water wells it is often of considerable importance that water and contaminants present in the upper earth strata that contain soil and sand do not flow down into the bore-hole drilled in the rock. To prevent this from happening it is common practice to drive a well casing down through the earth stratum and the upper rock strata, which are often fissured and therefore a potential risk that surface water and polluting matter present therein penetrate into the bore-hole. Alternatively, the well casing could be driven down in conjunction with the very hole-drilling operation, in which case an end cap, known as the drill shoe, of metal or other heavy material is attached to the end of the well casing.

Into the well casing and the drilled hole, two pipes are inserted so as to extend in parallel, through which pipes flows the medium by means of which heat exchange is carried out relative to the rock and the water supplies contained therein. At their top, the pipes lead to a heat pump or the like.

It is, however, also desirable that sealing is provided in the interior of the well between the upper part passing through the upper earth strata and the lower part extending into the rock, in order to efficiently prevent surface water and the like, often acidified, from reaching the groundwater.

Also, it is desirable to be able to make better use of the energy well and to extract more energy therefrom.

Consequently, one object of the invention is to provide means for more efficient sealing of wells, and in particularly of energy wells.

This object is achieved by means of a device and a method as defined in the appended claims.

For exemplifying purposes the invention will be described in more detail in the following with reference to the accompanying drawing figure, which shows the lower part of an energy well fitted with a seal in accordance with the invention.

An energy well designed in accordance with one embodiment of the invention, shown in the drawing figure, comprises a well casing 1 inside which circulation pipes 2 are located. Inside these circulation pipes a medium circulates, for example for a heat pump (not shown). The well casing is driven down through the soft surface layers of earth and sand and further down, into the rock. Preferably, the well casing comprises a stiff lower-end portion 3, acting as a drill shoe, which could be attached to the well casing by means of e.g. welding. Obviously other methods of fastening the shoe are likewise possible.

Furthermore, a tubular gasket 4 is arranged around at least some of the circulation pipes. For sealing between the circulation pipes and the tubular gasket a sealing compound 5 is placed between the pipes and the seal, said sealing compound preferably being of the type that swells upon its contact with a liquid. Consequently, the tubular gasket may easily be fitted over the circulation pipes while at the same time efficient sealing is achieved upon contact with a liquid, i.e. when sealing is required. The tubular gasket is disposed inside the well casing, and for this purpose it is configured with an external diameter that is at least slightly smaller than the inner diameter of the well casing. Also between the tubular gasket 4 and the well casing 1 there is positioned a sealing compound 6, the latter likewise

preferably being of a liquid-expandable kind. Preferably, the sealing compound is located between concentric and essentially adjoining surfaces.

The sealing compounds 5, 6 preferably are applied in the form of strings inside keyways or similar grooves formed in the tubular gasket.

At its lower part intended to project beyond the lower part 3 of the well casing, the tubular gasket preferably comprises a third annulus 7 of a sealing compound, preferably of the same nature as those mentioned previously, for the purpose of making sealing contact with the rock.

The lower part of the well casing preferably further comprises an inner upwardly facing abutment edge 8, i.e. at the lower well casing part at least one section is formed with a smaller interior diameter than the rest of the casing. Furthermore, the tubular gasket 4 is formed with a matching downwards directed abutment edge 9. This abutment edge 9 of the tubular gasket preferably is formed by configuring the upper part of the tubular gasket with a larger diameter than the lower part thereof. The larger diameter is only slightly smaller than the inner diameter of the well casing whereas the smaller diameter of the lower tubular gasket part is smaller than the inner diameter of the abutment edge 8. Furthermore, the abutment edges 8, 9 preferably are inclined such that they slope downwards, towards the centre of the tubular gasket. This arrangement centres the tubular gasket as the latter is being passed down into the casing while at the same time some additional sealing effect is achieved.

These abutment edges form abutment and stop means when the tubular gasket, after having been fitted around the circulation pipes, is pushed down through the well casing. Additional sealing compound may optionally be applied in the area of the abutment means in order to seal between the tubular gasket 4 and the well casing 1.

Preferably, the sealing compounds are made from a material that swells upon its contact with a liquid. As an example of a material of this kind may be mentioned that marketed by the Japanese enterprise C.I. Kasei Co., Ltd under the trade name Hydrotite®. Preferably the string of material is introduced in the shape of an annulus into peripherally extending keyways of matching configuration provided for the purpose.

As long as the sealing member remains out of contact with liquid and consequently does not expand, the sealing pressure against the surfaces surrounding the sealing member is low. It is therefore easy to locate the various parts forming part of the sealing system in their correct relative positions. When exposed to liquid, the sealing compound will expand heavily and in consequence thereof be pressed into efficient sealing contact with the adjacent surfaces, thus efficiently preventing undesirable liquid and any contaminants contained therein from passing past the sealed-off parts and down into the well hole, which would result in pollution of the groundwater or at least of water present in the bore hole.

The sealing compound could also be of a kind exhibiting delayed swelling ability following its contact with a liquid. Such delayed response may be achieved by application of a gradually dissolving delay-layer on top of the sealing compound. Alternatively, the material as such may have a composition ensuring the delay activity. This delay feature facilitates the mounting work.

At its upwardly facing part, the tubular gasket further advantageously is formed with pull-up means to facilitate withdrawal of the tubular gasket. Such pull-up means may comprise e.g. a loop 10 or the like, which may be coupled to a wire to allow the tubular gasket to be pulled up, out of the well casing. This allows retrieval of the tubular gasket, etcetera.

Preferably, the tubular gasket is made from a recyclable material, such as e.g. polyethylene (PE).

When an energy well having a well casing 1 has been placed inside the drill hole, the tubular gasket 4 is lowered down to the level of the drill shoe 3, where it is stopped and sticks as a result of its expansion. Owing to the efficient sealing effect obtained by means of the invention the level of water inside the drill hole may be increased by supply of water from above. This allows the well to be filled to a level located above the level of the groundwater, and possibly all the way up to ground level. In this manner, the quantity of water available for the heat exchange process becomes larger, allowing an increase of the amount of transferred energy. At the same time, the resulting well is guaranteed to be sealed off against surface water, which often may be acidified or contain other contaminants.

The circulation pipes could be part of a heat-pump system using a special heat carrier medium, as well as being water-carrying pipes used for supplying water from the associated well. The well could be used both for extraction of heat to a heat-pump system and for drawing drinking water. Also a combination of these kinds of pipes is possible without departure from the inventive idea. Likewise, it is possible to arrange the sealing compound differently from what has been shown herein and in other positions on the tubular gasket.

CLAIMS

1. A device in wells, and preferably energy wells, for sealing thereof, said wells being of a kind comprising a well casing (1) and circulation pipes (2) extending inside said well casing, preferably for the circulation of a heat-exchange medium, c h a r a c t e r i s e d by a tubular gasket (4), which is fitted around the circulation pipes (2) so as to enclose the latter at least around part of their extension lengthwise and which is arranged at the lower part of said well casing (1), a material (6) of a kind that expands upon its contact with a liquid, and in consequence thereof provides sealing, being applied about the tubular gasket (4) to seal between said tubular gasket and the well casing (1).

2. A device as claimed in claim 1, c h a r a c t e r i s e d in that a liquid-expandable material (6) is applied also between the circulation pipes (2) and the tubular gasket (4).

3. A device as claimed in claim 1 or 2, c h a r a c t e r i s e d in that at its lower, preferably rigid end portion (3) said well casing (1) comprises an inner upwardly facing abutment edge (8), and in that said tubular gasket (4) comprises a matching downwards facing abutment edge (9).

4. A device as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that in a section of said tubular gasket (4) that projects downwards below the well casing (1), said tubular gasket (4) also comprises an external sealing annulus (7), preferably made from a liquid-expandable material, for sealing against the surrounding rock.

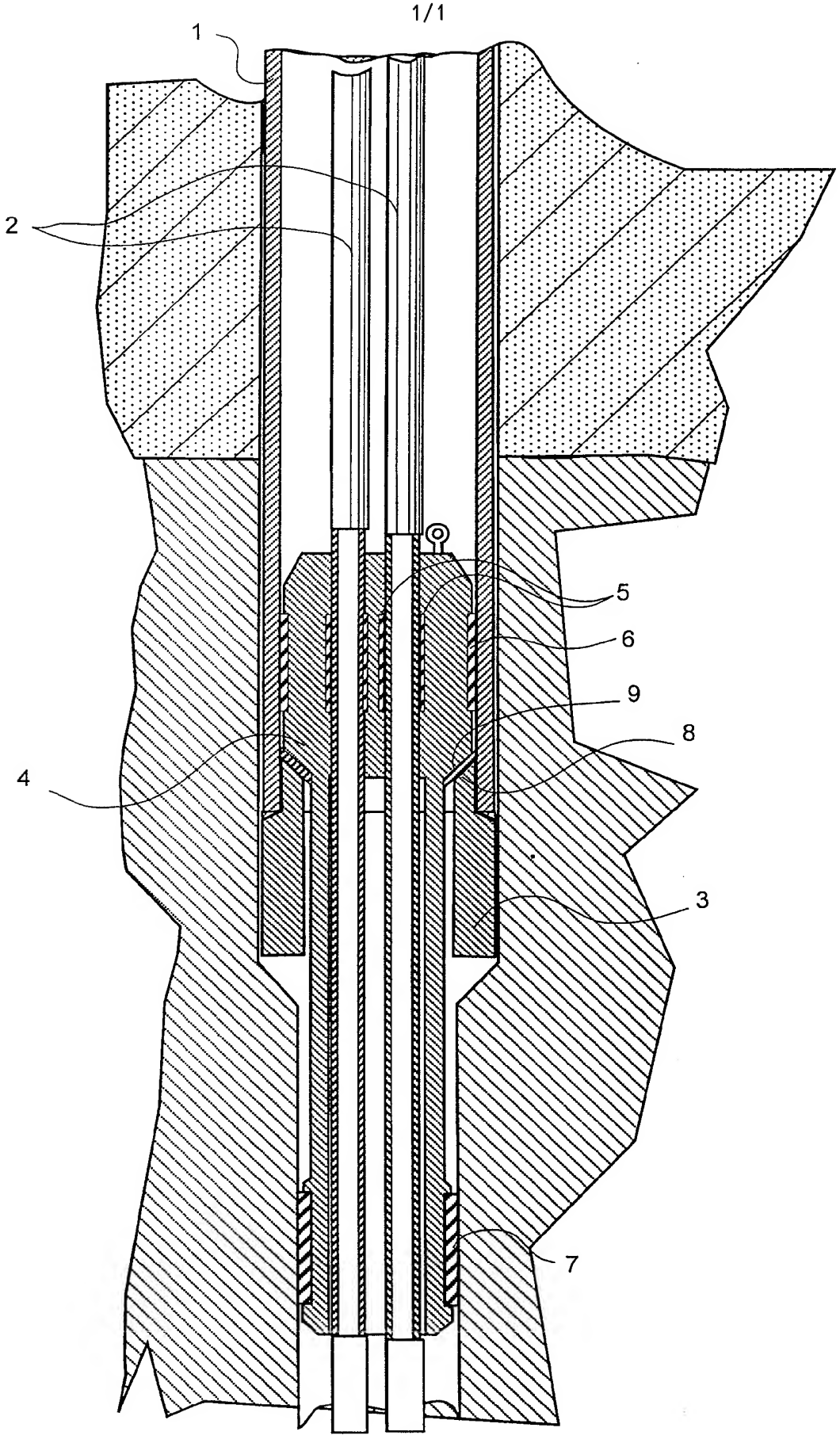
5. A device as claimed in claim in any one of the preceding claims, c h a r a c t e r i s e d in that the tubular gasket (4) may be pulled upwards via the well casing (1).

6. A method for sealing wells, preferably energy wells, of a kind comprising a well casing (1) and circulation pipes (2) extending inside said well casing, c h a r a c t e r i s e d in that a tubular gasket (4) is applied around the circulation pipes (2) prior to the latter being lowered into the well casing (1), and in that a sealing compound (6) of a kind that expands upon its contact with a liquid is applied about the tubular gasket (4) for sealing between the tubular gasket and the well casing (1).

7. A method as claimed in claim 6, c h a r a c - t e r i s e d by applying a sealing compound (5), preferably of liquid-expandable type, between the tubular gasket (4) and the circulation pipes (2).

8. A method as claimed in claim 6 or 7, c h a r - a c t e r i s e d by arresting the tubular gasket (4), when lowering it into the well casing (1), in a lower position by means of an abutment (8), said abutment acting against an abutment (9) of matching configuration formed on the tubular gasket (4).

9. A method as claimed in any one of claims 6-8, c h a r a c t e r i s e d by applying an external sealing annulus (7), preferably of a liquid-expandable material, about the lower part of the tubular gasket (4) for sealing against the rock below the well casing (1).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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/00328

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: E21B 33/12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SE 469394 B (H. ALEXANDERSSON ET AL), 28 June 1993 (28.06.93), page 3, line 24 - page 5, line 16, figures 2,3	1-9
A	US 5195583 A (D.A. TOON ET AL), 23 March 1993 (23.03.93)	1-9
A	US 5048605 A (D.A. TOON ET AL), 17 Sept 1991 (17.09.91)	1-9
A	SE 466869 B (H. ALEXANDERSSON ET AL), 13 April 1992 (13.04.92)	1-9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

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